

Grand Canyon Visibility Transport Commission (GCVTC)

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Overview of Presentation

- Organization and Scope
- Policy assessments
- Technical assessments
- Public Advisory Committee (PAC) report
- GCVTC recommendations to EPA

GCVTC Highlights

- Established in 1991 to study 16 class I areas
- Nine state transport region.
- 200+ participating regulators/stakeholders
- Four-year science/policy analysis process projecting emissions/visibility 1990-2040
- Identified strategies to address regional haze
- Report submitted to EPA in June 1996

**Grand Canyon
Visibility Transport
Commission**

GCVTC Recommendations

The Grand Canyon Visibility
Transport Commission

Recommendations
for Improving
Western Vistas

June 10, 1996

GCVTC Membership

- **Governors (or Designees) of States**

Arizona (Chair)	Nevada
Utah (Vice Chair)	New Mexico
California	Oregon
Colorado	Wyoming

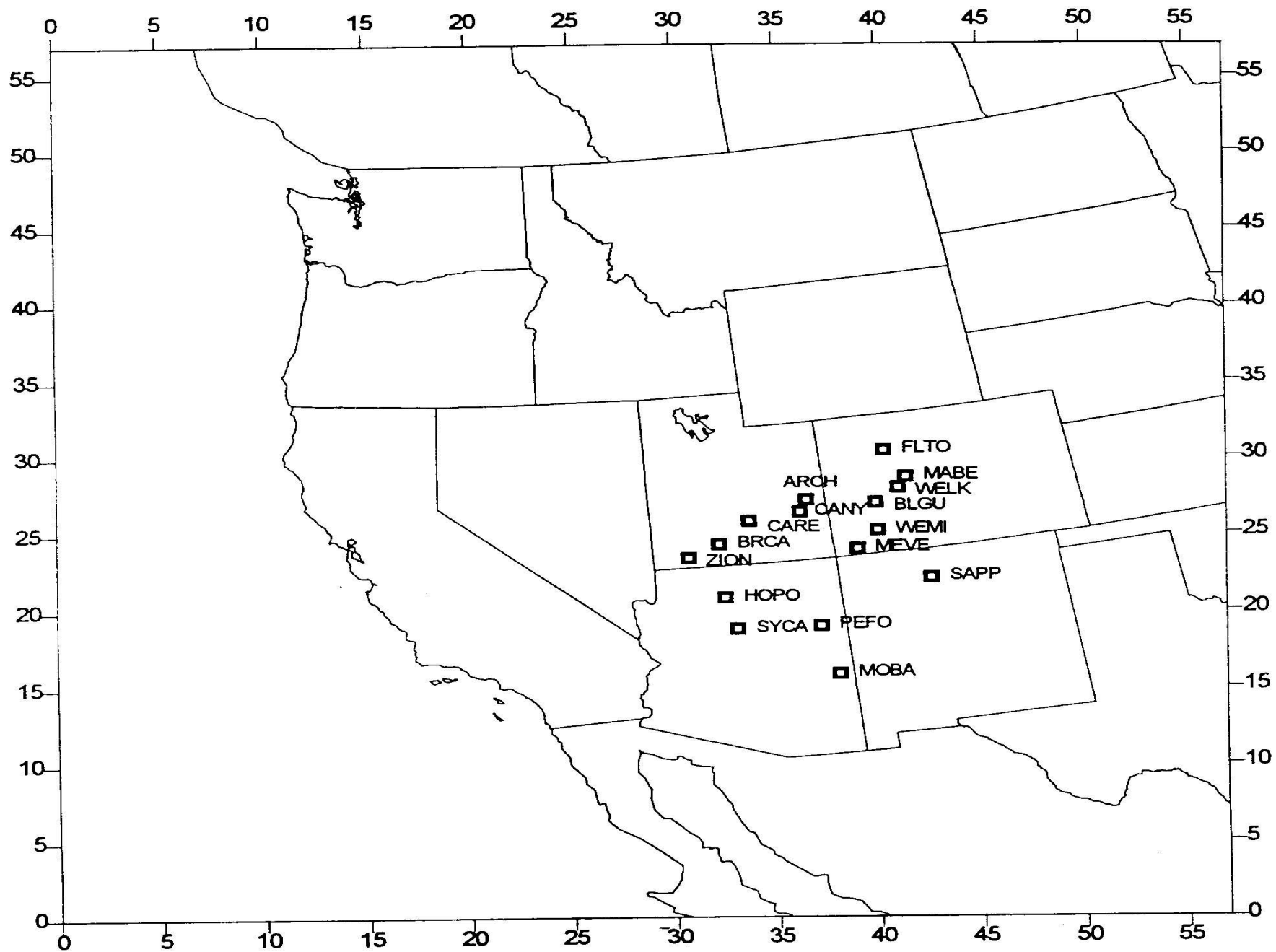
- **Native American Tribal Leaders**

The Navajo Nation	The Hopi Tribe
The Pueblo of Acoma	The Hualapi Tribe

- **Ex-officio Members**

US Forest Service	US Fish & Wildlife Service
US National Park Service	Bureau of Land Management
US Environmental Protection Agency	
Columbia River Inter-Tribal Fish Commission	

- **Commission Office:** Western Governors' Association, Denver, CO



GCVTC 16 Class I Areas

Utah

Zion National Park
Bryce Canyon National Park
Capital Reef National Park
Canyonlands National Park
Arches National Park

Arizona

Grand Canyon National Park
Sycamore Canyon Wilderness
Petrified Forest National Park
Mt. Baldy Wilderness

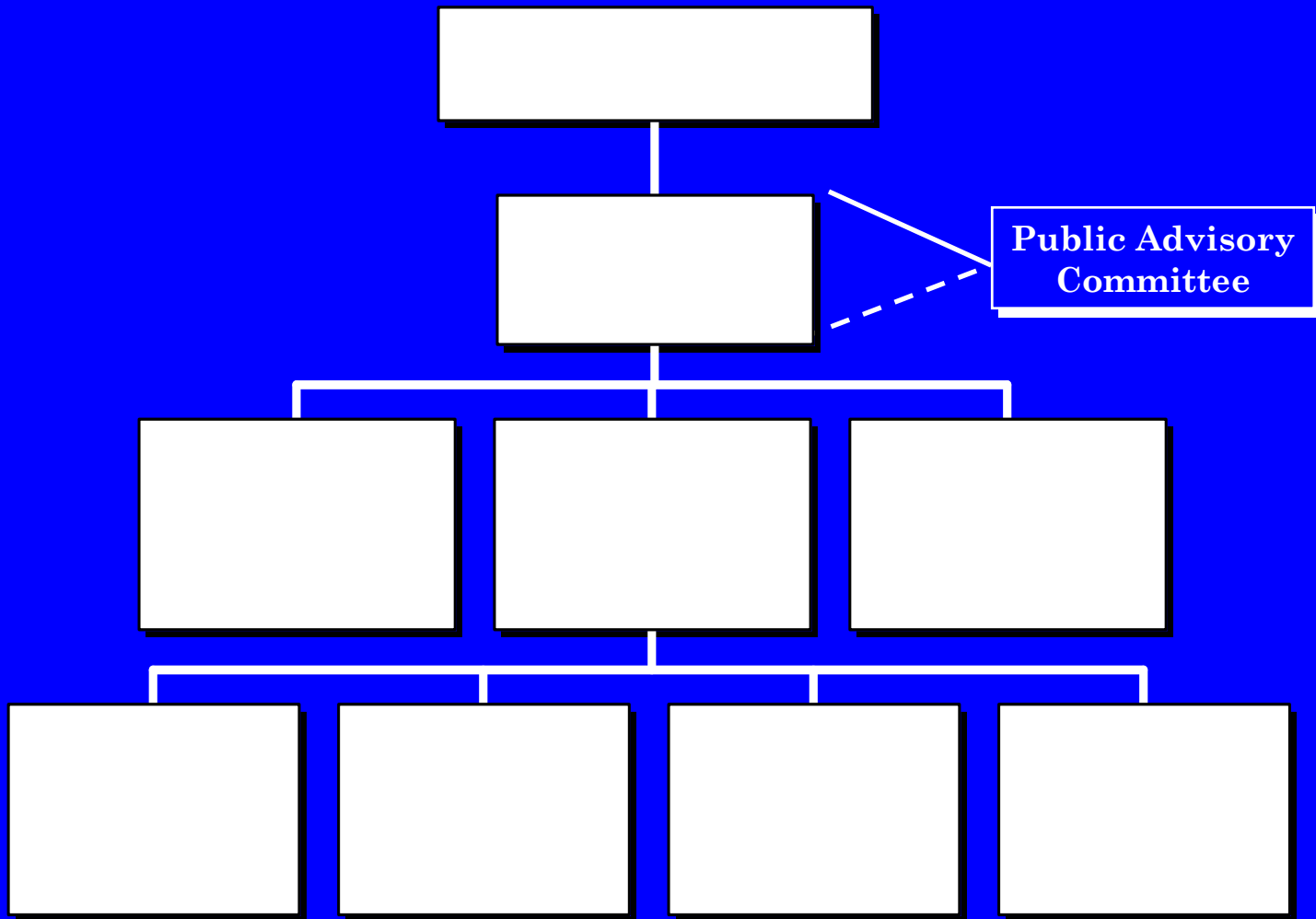
Colorado

Flat Tops Wilderness
Maroon Bells Wilderness
West Elk Wilderness
Black Canyon of the
Gunnison Wilderness
Weminuche Wilderness
Mesa Verde National Park

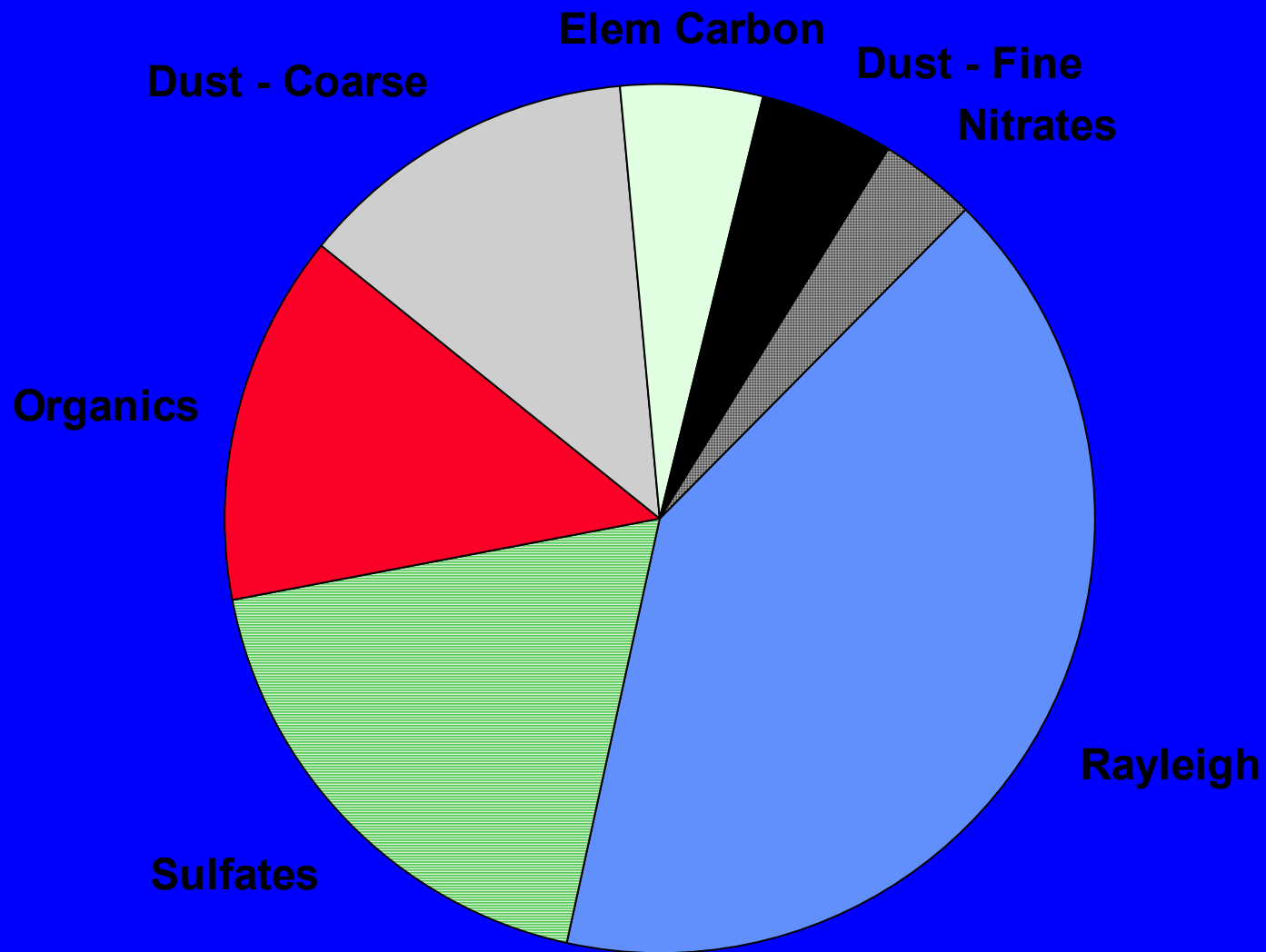
New Mexico

San Pedro Parks Wilderness

GCVTC Organization



1990



GCVTC Objectives

- Determine what actions, if any, are needed
- Assessment of Current State
- Forecast of Future State (thru 2040) based on growth
- Evaluation of options for improvement
 - Primary: Visibility and Costs of Controls
 - Secondary: Economic, Social, Environmental, Equity, Administrative
- Recommendations to EPA on actions and needs

GCVTC

Emission Management Scenarios

- Bounding Scenarios
 - Baseline Forecast Scenario (Current Requirements under CAA w/o regional haze)
 - Maximum Management Alternative (MMA) (All controls possible regardless of cost)
- Intermediate Management Scenarios (IMSs)
 - Regional Emission Cap/Market Trading
 - Visual Air Quality Objectives
 - Control Technology/Standards

Baseline Forecast Scenario

- Compute ‘baseline’ visibility at receptors
 - current year
 - future years (e.g., 2000, 2010, 2040)
- Also referred to as the “current law” scenario, used to examine how current state, tribal and federal air quality laws are expected to affect visibility once they are fully implemented.

Emission Management Scenarios

- The Maximum Management Alternative
- Regional Cap/Market-based
- Visibility Standard
- Technology Application
- Concepts to be Considered
 - Clean Air Corridors (CAC)
 - Voluntary Emission Reductions
 - Incentive and Disincentive Programs
 - New Source Review requirements to assess the impact of new pollution sources on visibility

Emission Management Scenarios

- Maximum Management Alternative (MMA)
 - Under this option, consultants will determine what is the most that can be done to improve visibility on the Colorado Plateau, how much those changes would cost if they were implemented, and to what extent visibility would improve.
 - This would set an upper boundary for the study.

Emission Management Scenarios

- Regional Cap/Market-based
 - This is one of three scenarios that uses emission reduction levels to improve visibility.
 - The establishment of regional emission caps would limit the amount of pollutants released into the air that travels through the Colorado Plateau.
 - A market-based approach would allow economic expansion to continue through the use of emission trading.

Emission Management Scenarios

- Technology Application
 - Under this option, emission reductions would be achieved with the adoption of standardized control technology requirements for those entities contributing to pollution that impairs visibility.

Emission Management Scenarios

- Visibility Standard
 - This option would establish a visibility standard.
 - For example, the standard could require a specific number of clear air days or an average distance of visibility.
 - Ways to achieve a visibility standard and potential deadlines will be presented.

GCVTC Evaluation Criteria

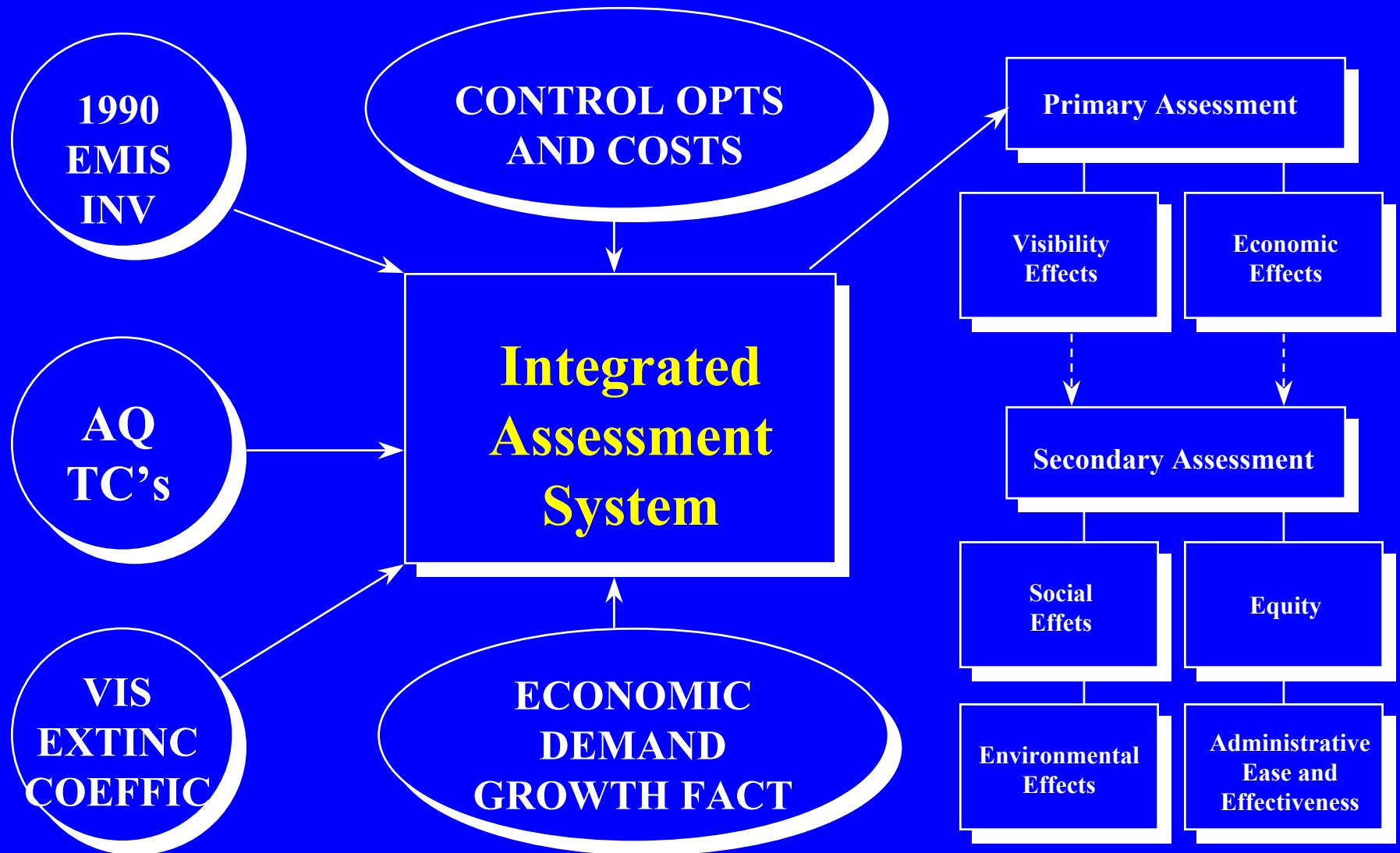
- Visibility Effects (in Class I Areas)
- Economic Effects
- Social Effects
- Other Environmental Effects
- Equity
- Administrative Ease and Effectiveness

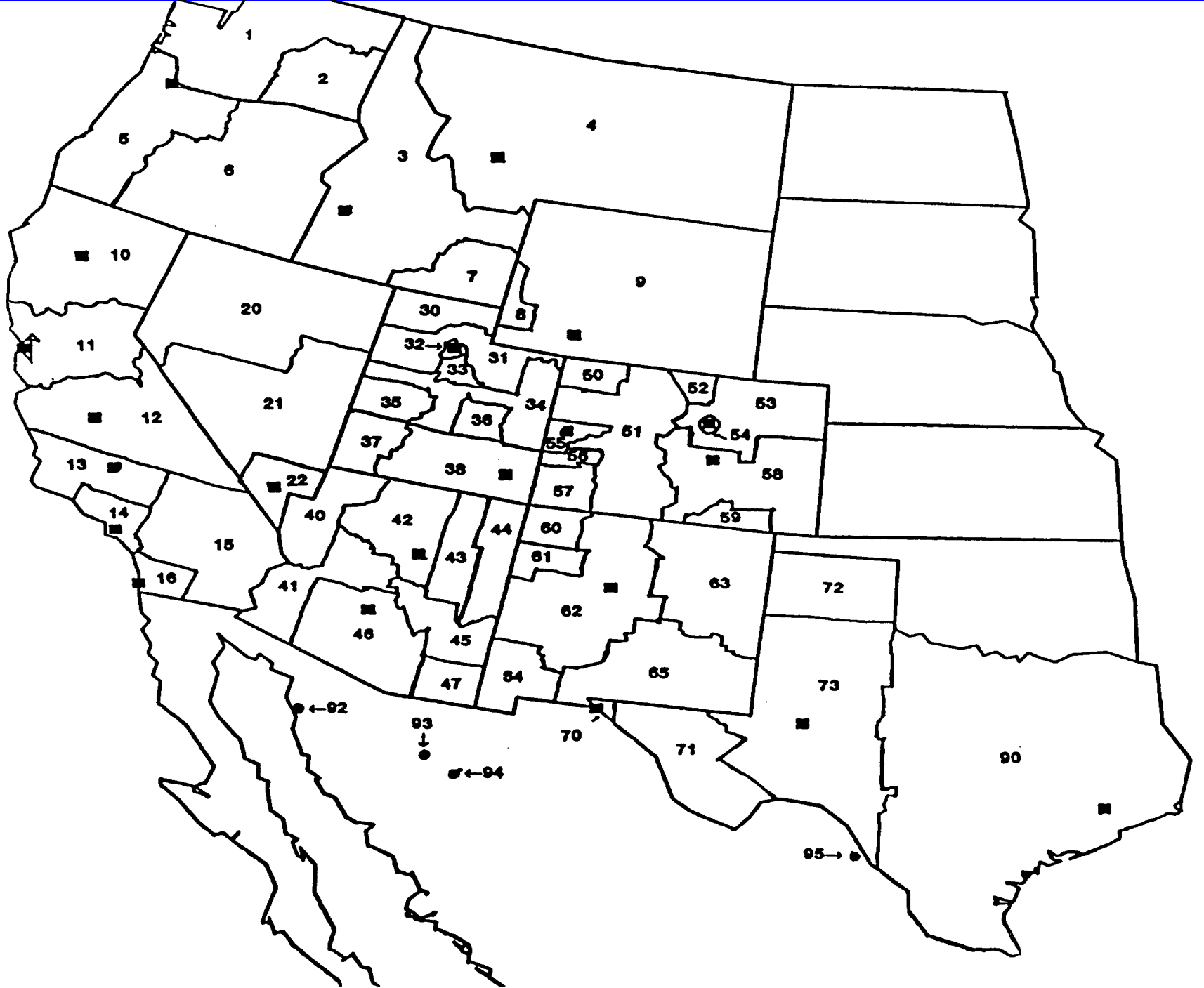
GCVTC Assessment Needs

- Primary Assessment - Integrated Assessment System (IAS) 1990-2040
 - Direct Control Costs and Impact on VAQ
- Secondary Assessment - Experts w Primary Results
 - Economic, Social, Environmental, Equity, Administrative

Integrated Assessment System

- Base Emission Inventory - Source Cells (Region/Sector/Size/Pollutant/New vs Old)
- Economic/Demographic Forecast Growth Factors (Overall Sector Demand)
- Retirement Assumptions (of Old Sources)
- AQ Transfer Coefficients
- Extinction Efficiencies
- Control Options and Costs





Secondary Assessments

- Economics
 - What will the cost be to controlled entities?
 - Will there be increased taxes/costs to the public?
 - Will better visibility improve tourism or public health?
- Social effects
 - Will fundamental lifestyle changes be required?
- Other environmental effects
 - Positive or negative impacts to endangered species or on hazardous waste disposal?

Secondary Assessments

- Equity
 - Will any state, group of people or industry be unfairly burdened?
 - Will contributors to problem contribute to solution?
- Administrative ease and effectiveness
 - Reasonable cost and administrative structure?
 - Consistent with current laws/programs?

Technical Objectives

- Relate speciated emission rates (Q) from source areas to fine particle concentrations (C) and visibility impairment (b_{ext}) at receptors
- Determine changes to species concentration (C) and overall visibility impairment (b_{ext}) at receptors due to enacting pollution controls that reduce emissions from certain source sectors and source areas

GCVTC Technical Subcommittee

- Emissions - Inventory & Forecasts
- Aerosol & Visibility - extinction efficiencies
- Meteorology - Wind/Met Fields
- Modeling - AQ Modeling & Reconciliation

Overview of Methodology

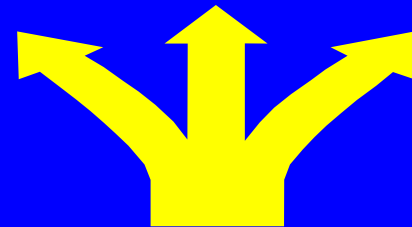
- Source area speciated concentration contributions at receptors are found by multiplying source area TCs by source area speciated emission rates
$$C = Q \times TC$$
- Develop speciated transfer coefficients (TCs) from source areas to receptors by running regional scale meteorological and air quality models

Overview of Methodology

- Reconcile model predictions of speciated particle concentrations to observations by scaling TCs so the average of predictions and observations match
- Integrated Assessment System is run with reconciled TCs to identify current and future speciated predicted impacts from source areas and visibility

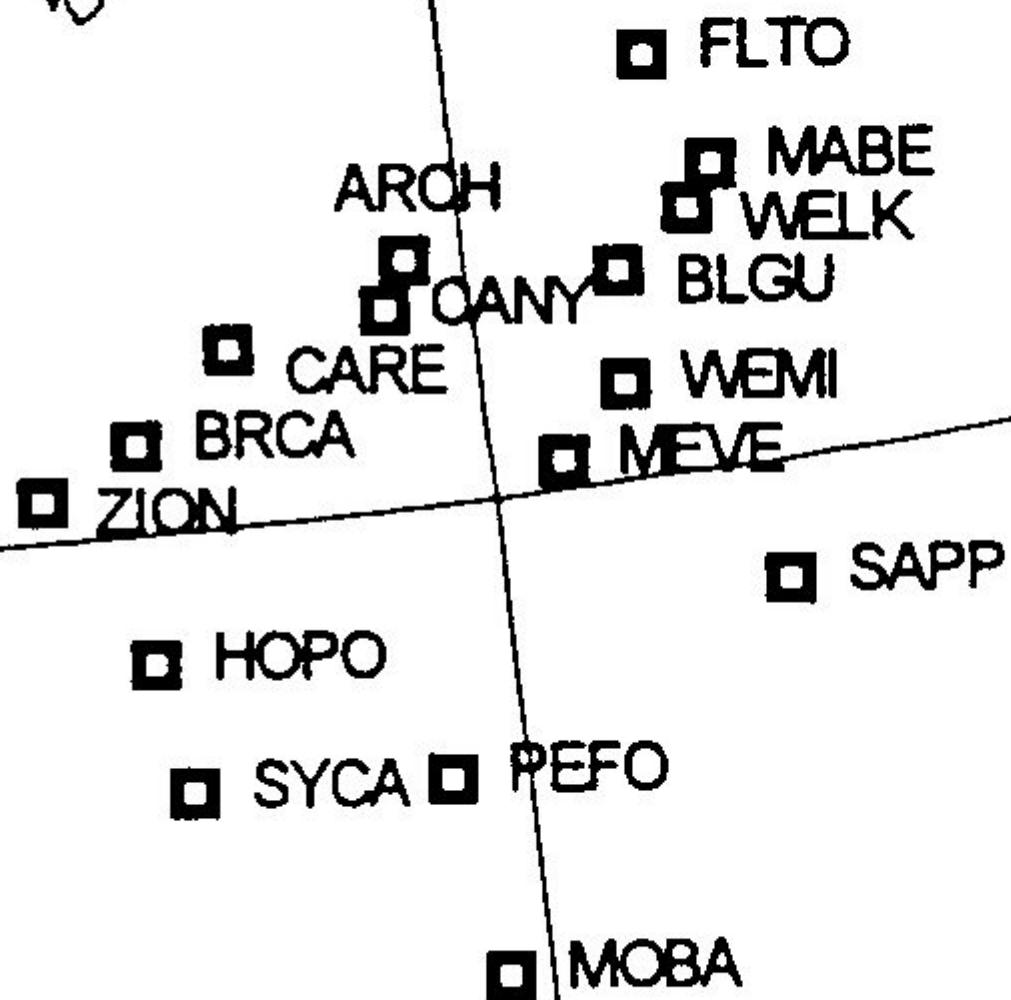
Developing Transfer Coefficients

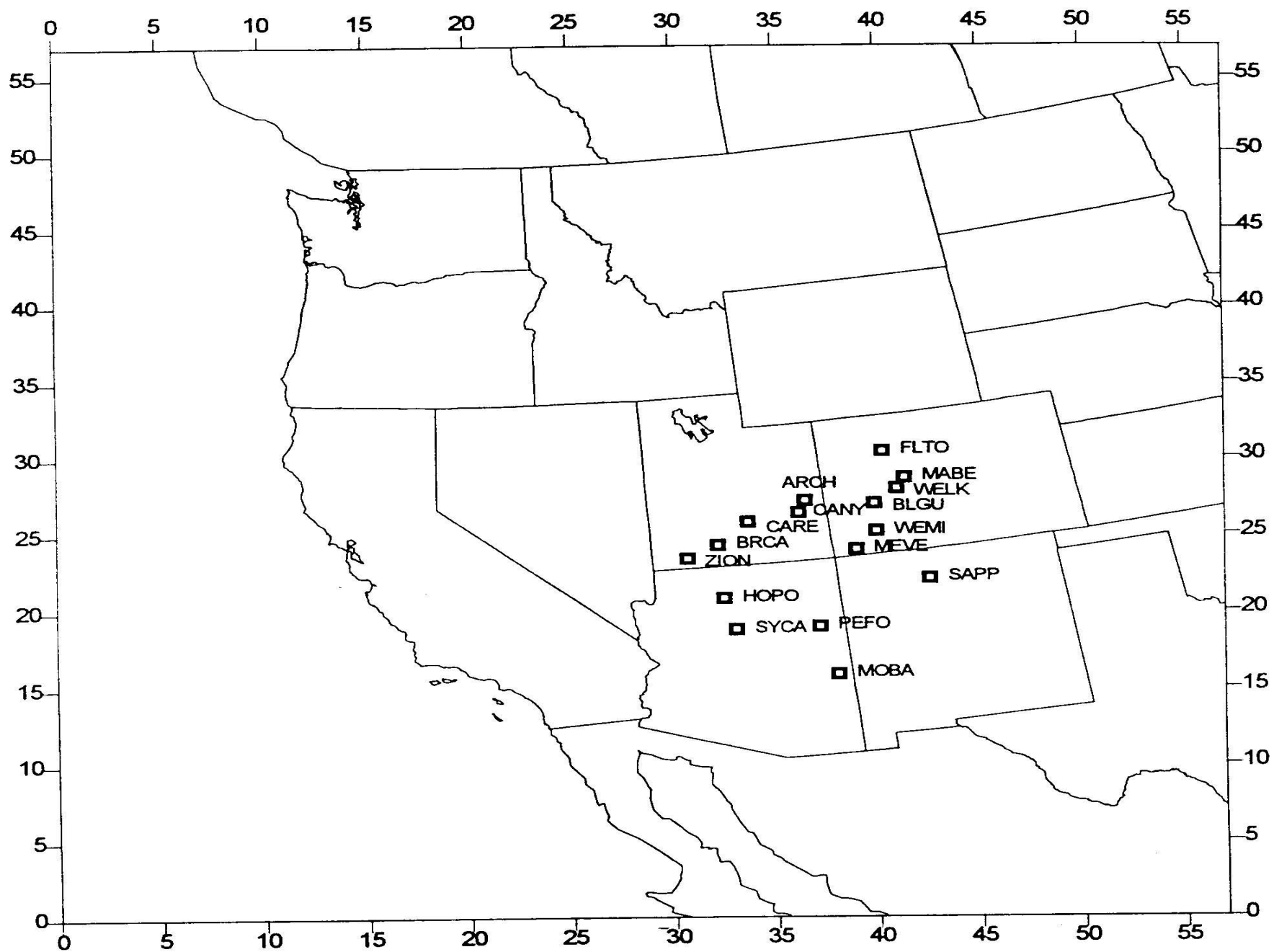
- Temporal and Spatial Meteorological Data Set
- Gridded speciated emission inventory
- Regional Scale Inert and Chemical Reactive Air Quality Model (e.g., **VARED**, RADDM, UAM)



Developing Transfer Coefficients

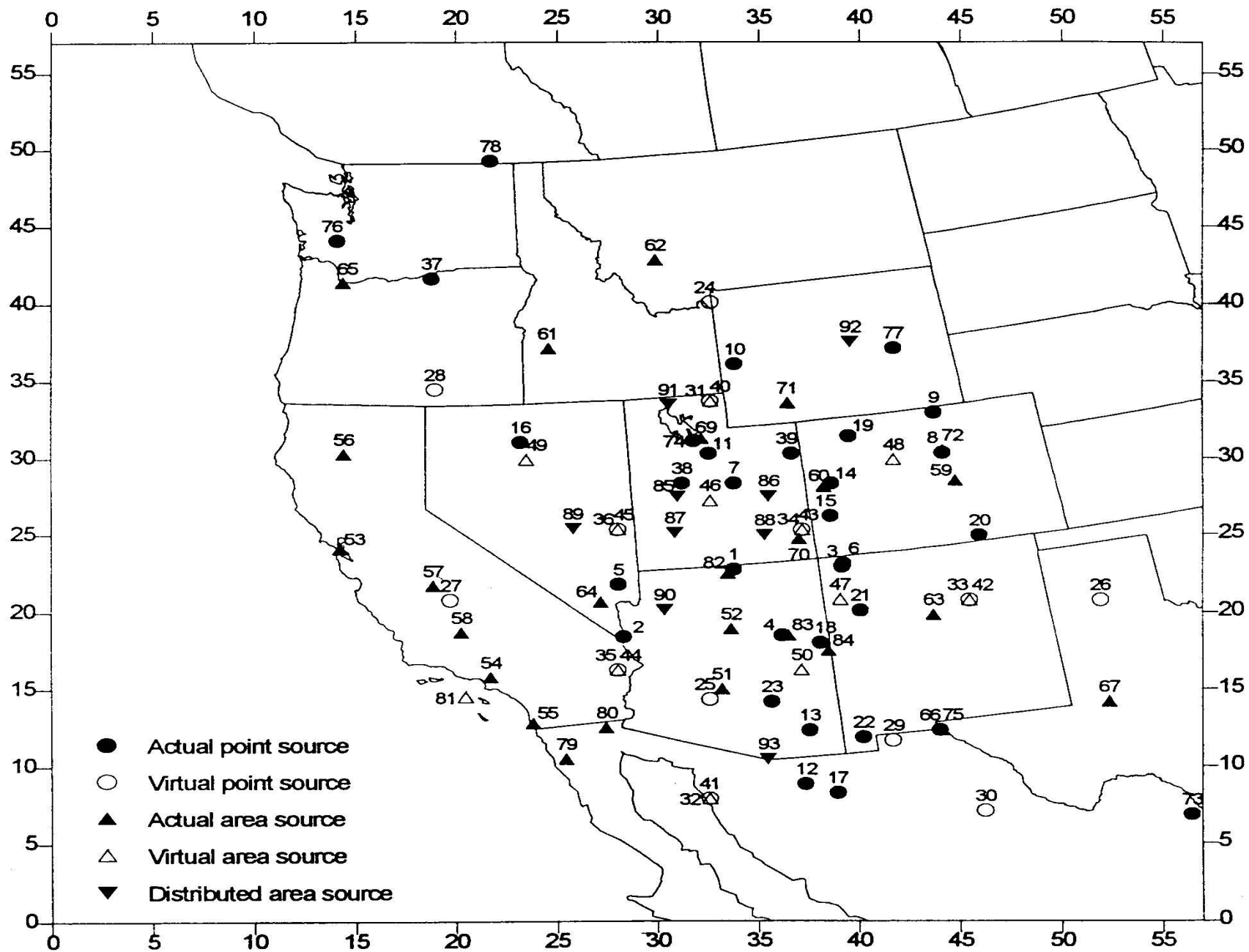
- Select Receptors & Define Model Domain
- Select Meteorological Model
 - Obtain Meteorological Input Data
 - Output Meteorological Fields
- Select Air Quality Model
 - Obtain Input Data
 - Output Speciated Fine and Coarse Particle Concentrations and TCs by source area





Emission Inventory Sources

- Area sources like agriculture-related activities, residential fuel combustion, and road dust
- Biogenic sources such as forest fires, forest management and other waste burning, lightening, and soil and vegetation
- Mobile sources like off-road and on-road motor vehicles
- Point sources such as power plants, refineries, and smelters



Regional Scale Meteorological Model

- Inputs
 - Spatial and Temporal Surface and Upper Air Meteorological Data
 - Winds
 - Temperature
 - Mixing/Boundary Heights
- Outputs
 - Temporal set of gridded wind, temperature, and micrometeorological fields

Air Quality Model

- Inputs
 - Gridded Meteorological Data
 - Gridded Speciated Emission Inventory
 - SOX (gaseous and particulate sulfur oxides)
 - NOX (gaseous and particulate nitrogen oxides)
 - Ammonia (NH₃)
 - Organic Carbon (OC) [Aromatics/Terpenes/Biogenics]
 - Elemental Carbon (EC)
 - OFM (Other Particulate Matter less than 2.5 microns)
 - PM₁₀* (Particulate Matter between 2.5 and 10 microns)

Air Quality Model

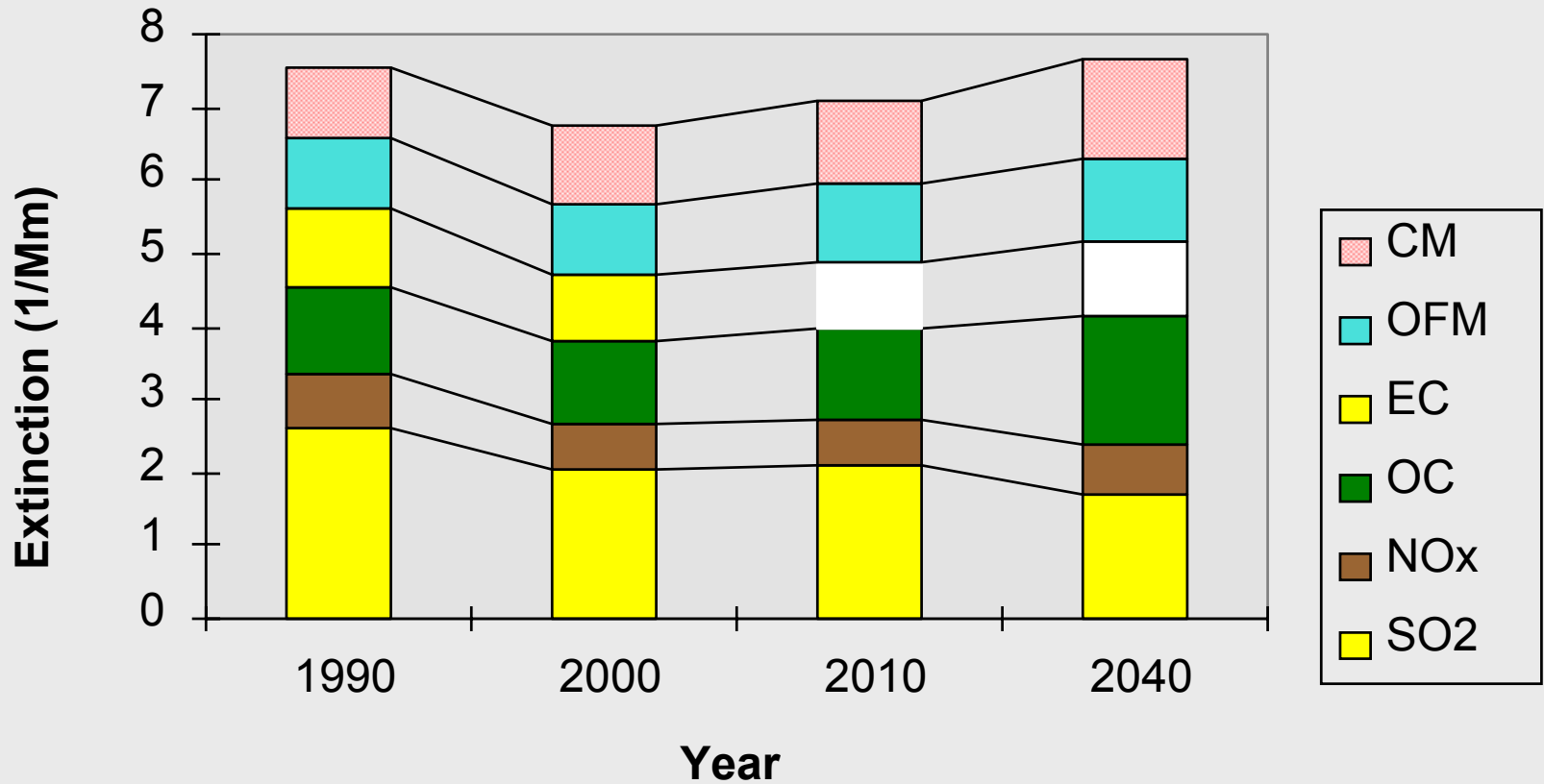
- Outputs
 - Time Series of speciated concentrations
 - Time Series of source area transfer coefficients (TCs) reflective of a species impact at a receptor (730 12-hour TC'S) from either:
 - an individual grid square;
 - an average of multiple grid squares; or
 - an emission weighted average of multiple grid squares

Uncertainty of Model Predictions

- Meteorological Model
 - temporal and spatial resolution of meteorological data
 - accuracy of wind measurements and model predicted wind fields in the absence of data
- Air Quality Model
 - current and future emission inventories
 - instantaneous vs. seasonal/annual emission inventories
 - parameterizations used for dispersion, chemistry, and deposition velocities

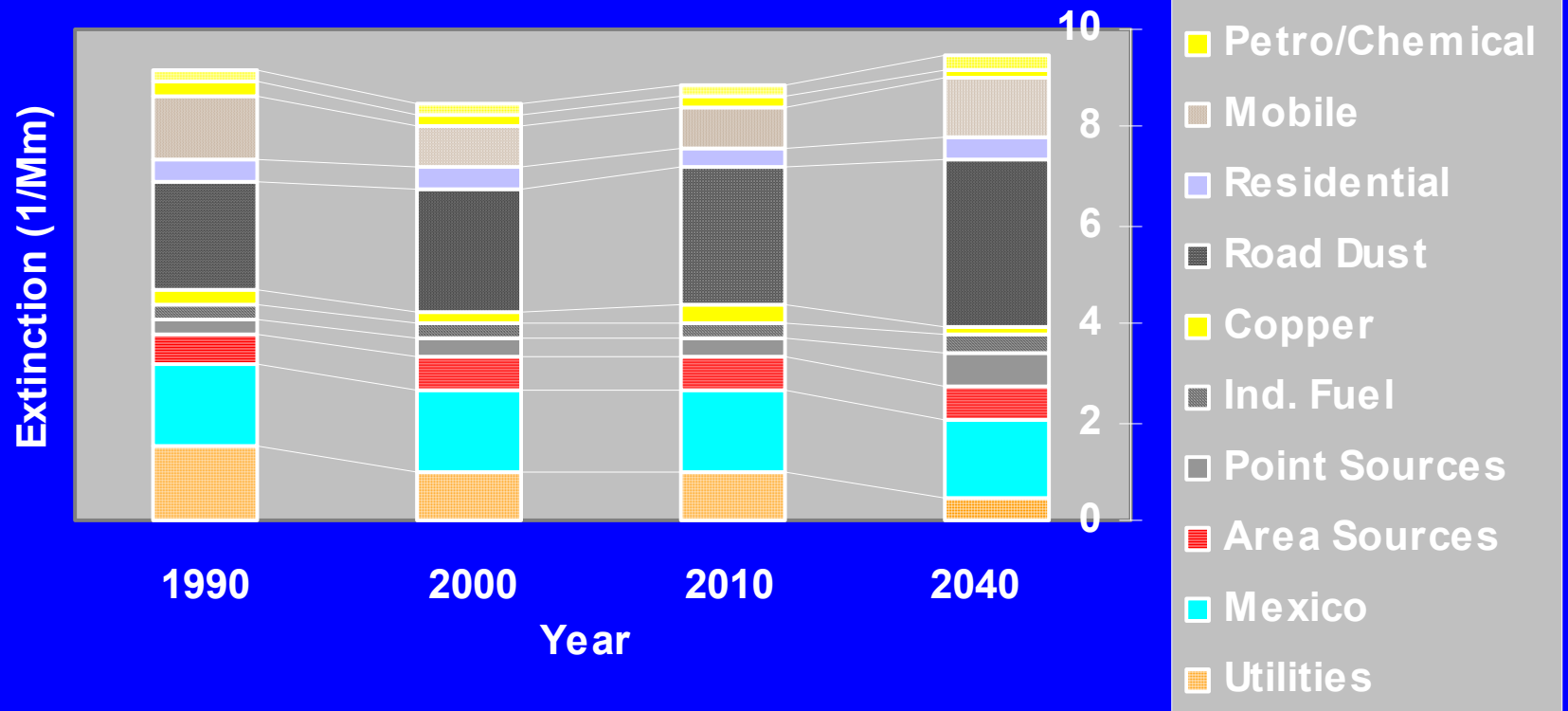
IAS - Baseline (Man-made only)

Grand Canyon National Park

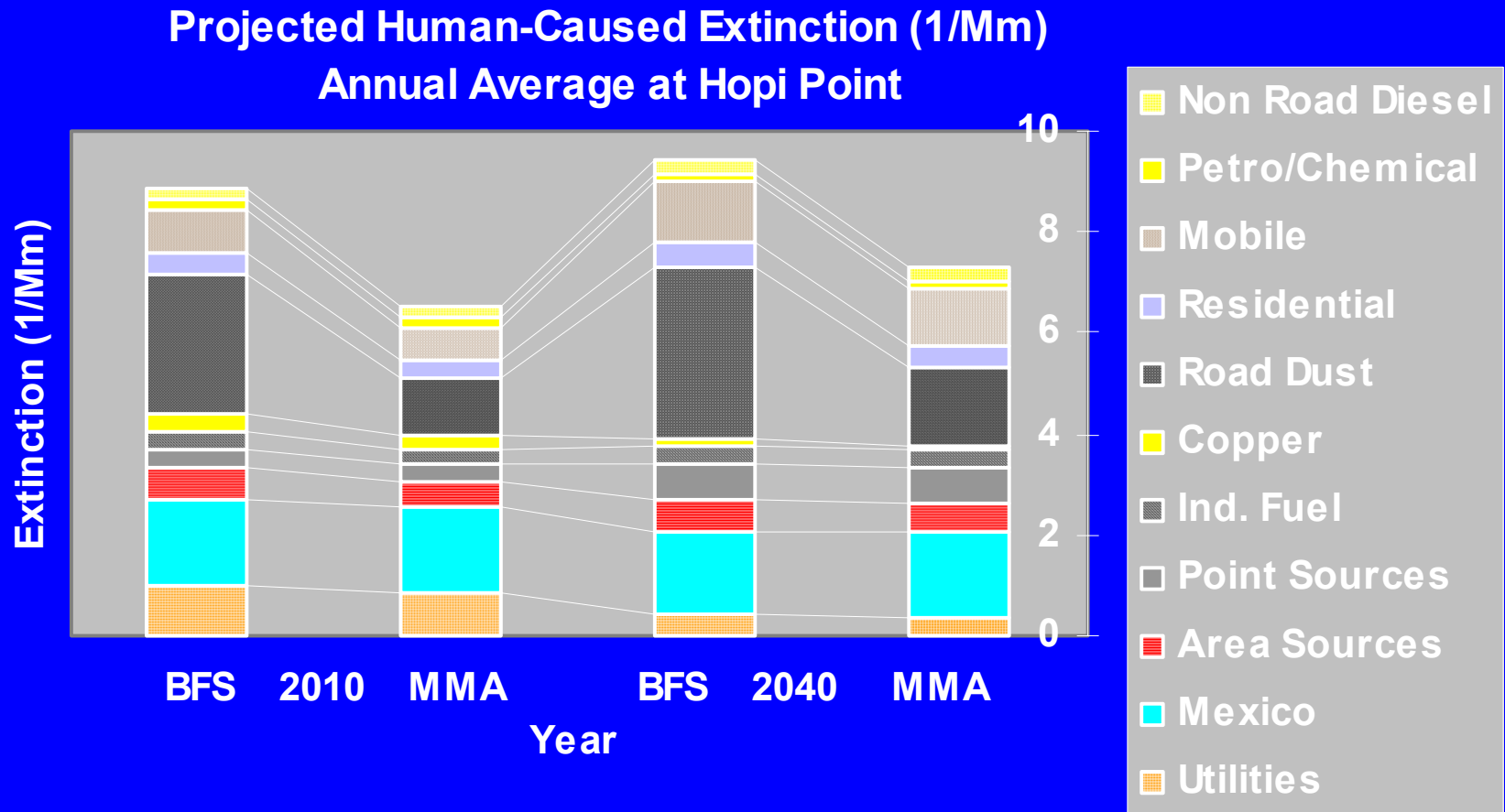


IAS Baseline Forecast

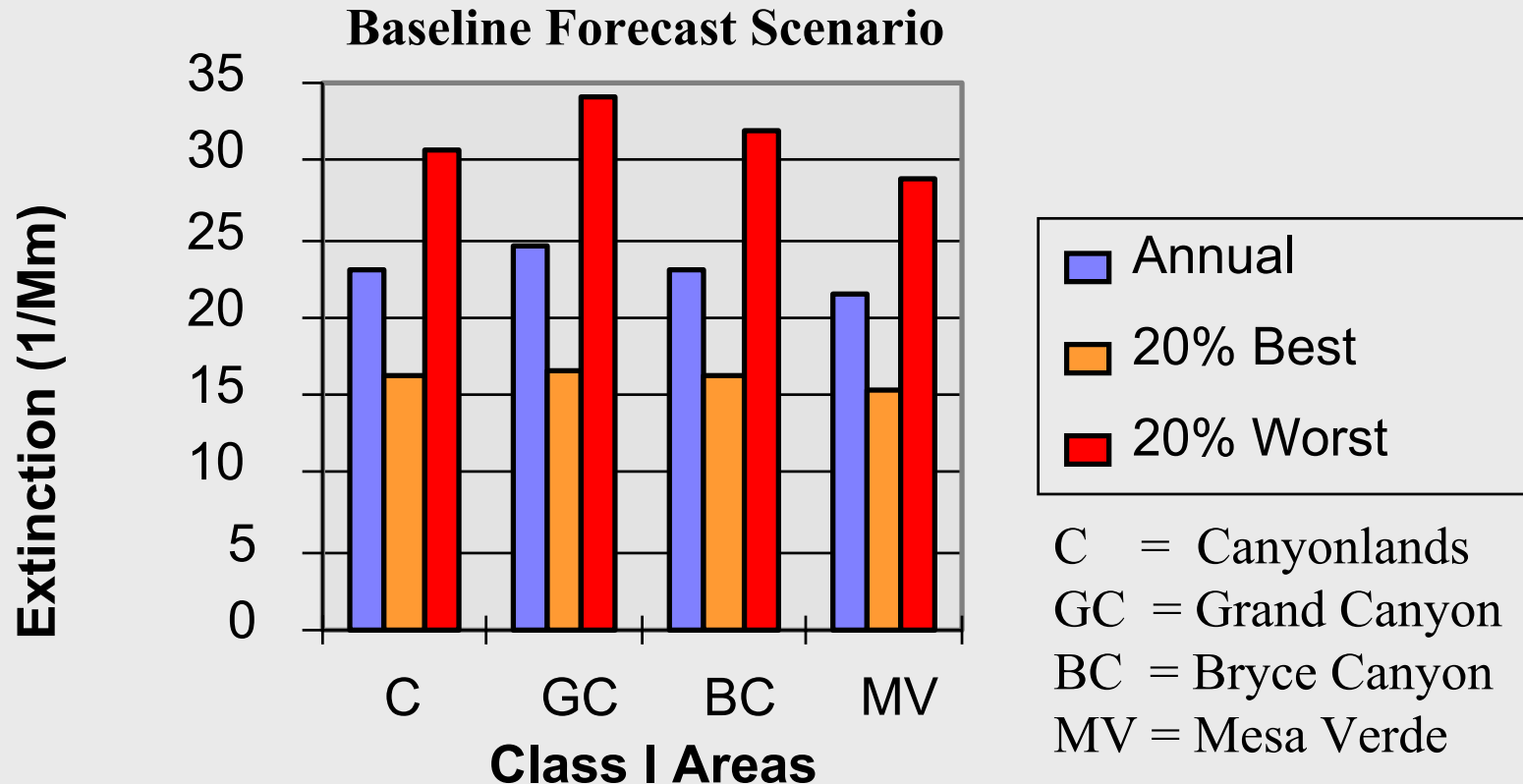
Projected Human-Caused Extinction (1/Mm)
Annual Average at Hopi Point



IAS Baseline vs MMA



Visibility on 20% best, average, & 20% worst periods



**With 80% MMA visibility improves by 0.5 1/Mm on 20% best,
1.4 1/Mm on annual, and 1.9 1/Mm on 20% worst**

MMA Assessment Findings

- Costs of controlling air emissions
 - \$0.5 billion/year for 25% of MMA reduction
 - \$1.8 billion/year for 80% of MMA reduction
- Limitations of Cost Estimates
 - based on historic pollution control costs, the rising costs have not been estimated
- For the 80% MMA case a decrease is predicted in overall employment in 2020 of up to -0.4%

Public Advisory Committee

- Charged by Commission to develop a consensus recommendation for consideration by the Commission
- 80+ Stakeholders
- 2-year education/deliberation process
- Many Utah stakeholder members

GCVTC Conclusions

- Visibility should improve over next decade under Baseline (current CAA)
- Regional cap and market trading program on SO₂ emissions will be developed in case reductions don't occur by 2000
- National programs for vehicle emission standards

GCVTC Conclusions

- Fire impacts are projected to decrease visibility in the future
- Clean Air Corridor
 - no perceptible negative impact on visibility in future years
 - no inequitable restrictions should be imposed on corridor residents and/or economic growth
- Emissions within & near Class I areas require further study

GCVTC Conclusions

- Impact of Mexico and off-shore ships
 - can they be ‘managed’
 - issue requires further study
 - emissions expected to increase
- Place high priority on pollution prevention (Renewable energy, Economic incentives, etc)
- Establish follow-up organization

GCVTC Future Work Needs

- Improved modeling of road dust
- Emission tracking of fire activity
- Track and monitor emissions in CAC
- Track and Monitor Source Emissions
- Implement mobile source emission budgets for select urban areas
- Develop cooperative agreement with Mexico to reduce emissions near border

Bryce Canyon National Park

